

*A broken sewer line and an improperly designed automatic lawn sprinkling system, which permitted bayou water to enter the city's main, led to 72 cases of enteritis in Shreveport, La.*

## An Epidemic of Enteritis Laid to Cross-Connection

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THE INCREASING use of water by a modern household for its many appliances increases public health hazards related to the water supply. The creation of more cross-connections, backflow connections, and open connections to accommodate these appliances and devices demands that sanitarians remain vigilant to prevent contamination of the water supply.

The misuse of one such device, an automatic lawn sprinkling system, led to contamination of the city water supply, resulting in an epidemic of enteritis in Shreveport, La.

In the summer of 1947, Mr. X installed a pump in Bayou Pierre, which flows behind his property, to supply water to the sprinkling system for the rear lawn of his home. His property is located in the southeastern area of Shreveport, the wealthiest residential section of the city.

In 1953 Mr. X installed for his front lawn an underground sprinkler system which drew its water from the city supply. This sprinkler system having been laid out in conformity with Shreveport's plumbing code, Mr. X applied to the city for a tap and meter for the system.

In June 1954, Mr. X installed an automatic time clock system and a booster pump in his

yard to use the bayou water for his whole sprinkler system. At the same time, he replaced the pump in the bayou with another of 10-horsepower capacity. He thought that the automatic timing system prevented a cross-connection. When the front sprinkler was connected to the bayou water system, the bayou water was not completely cut off from the city water main. Only a manually operated valve intervened between the city system and the bayou water system for the front lawn. This setup maintained a pressure in the sprinkler line of 65 pounds. Apparently, however, the pressure in the city water main at this point was at no time greater than 58 pounds.

Unfortunately, no inspection by the city plumbing inspector was requested. Mr. X's yardman, not knowing the hazard, opened the valves from the city water supply to prime the booster pump and left them open. Thus, when the time clock set the system into operation every 24 hours, water from both the bayou and the city main was forced through the system at the same time. Water from the bayou was probably forced into the city main for a fairly long period, since the two gate valves were found in the open position.

### The Investigation

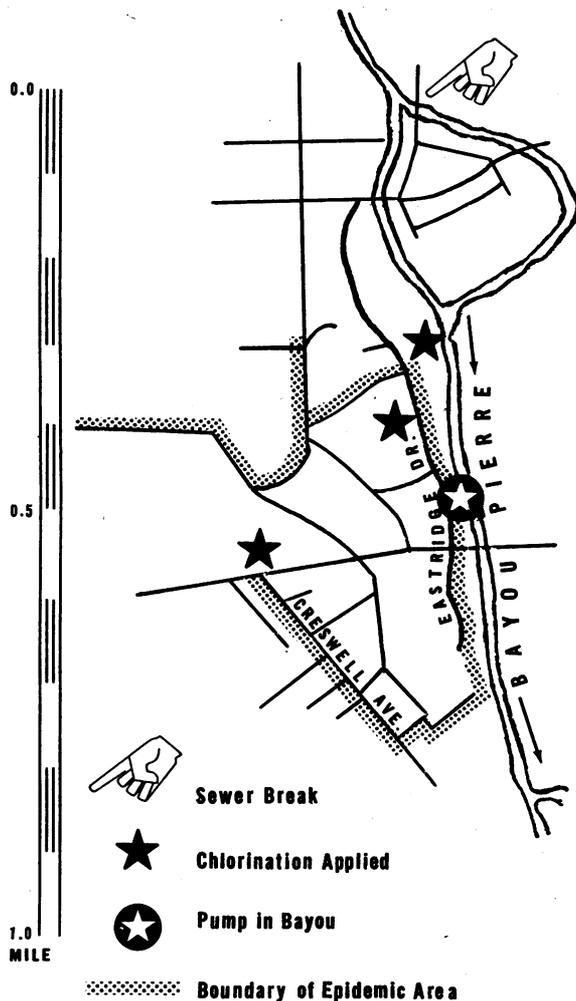
On August 7, 1956, a broken sewer line just off Bayou Pierre, about one-half mile from Mr. X's pump, was reported to the health department (see map). Investigation on August 8 revealed that the sewage from the broken line was draining into the bayou, and that the break had occurred about the beginning of August. Previously, the bayou water was fairly clear.

On August 8 the sewer break was corrected. The same day, the office of Shreveport's commissioner of public utilities received a call from a resident who said that the hydrant water in

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## Site of enteritis epidemic in Shreveport, 1956



his house appeared green. An investigation was made, but the health department was not notified.

On August 11 a neighbor of Mr. X phoned the Caddo-Shreveport Health Department, stating that he, his wife, and his children were sick. He said there was a rumor that the water was bad. A sanitarian was immediately sent to the address to collect some water samples. The health department had no knowledge prior to this call of anything amiss with the city water supply. Because of the broken sewer line and the characteristics of the water, it was thought that sewage entering the bayou at this point was contaminating the water supply in the area.

On August 13, the water samples showed that heavy coliform contamination was entering the city water supply in the area where the com-

plainant lived. Eleven sanitarians went there immediately and began a search up and down the bayou for a possible cause of the bayou water entering the city supply. Within 2 hours they located Mr. X's pump in the bayou.

Some dye was put into the pump line to ascertain if the material would eventually reach the city main. The dye was detected shortly afterward in all the outlets in Mr. X's yard and in the city fire hydrant across the street.

As soon as there was proof of a direct connection between the bayou water and the city main, Mr. X was advised of the situation and asked to discontinue the use of the pump. He complied immediately.

The city water department severed the cross-connection and disconnected the water main from Mr. X's property. The contaminated line was flushed with clean water, and a heavy chlorine solution was allowed to remain in the line for a day or two. This procedure was repeated on several occasions, water samples being taken after each flushing. Beginning August 13, the sanitarians collected more than 300 water samples in the vicinity of the affected area and kept a continual surveillance of the water lines for chlorine residual. The people in the area were advised not to drink the water or else to boil it before use.

On August 14, health department nurses made a house-to-house canvass of the affected area for more epidemiological information. They found that approximately 70 persons had developed enteritis. The symptoms, similar in most cases, were nausea, vomiting, abdominal pains, tenesmus, and diarrhea, the latter bloody in some cases.

In laboratory examinations of stool specimens of some patients, *Salmonella infantis* was isolated from 1 specimen, *Salmonella panama* from 1, and *Giardia lamblia* from 2. *Salmonella oranienburg* was isolated from 1 water sample.

The local health officer and other physicians who attended patients made a diagnosis of dysentery on clinical evidence. Because of the danger of infectious hepatitis, gamma globulin was obtained from the Louisiana State Department of Health to administer to those who had been ill.

On August 23, none of the water samples

were positive. The water supply was officially declared safe for use 5 days later.

### Analysis of Data

The data collected showed that 40 females and 32 males developed enteritis. Most of the cases occurred in children under 10 years of age, and in adults 35 years of age and over; only 2 were in infants. The total of 72 cases, none fatal, occurred in 27 households whose population was approximately 125. The attack rate, therefore, was about 60 percent.

Fifty-six of the cases occurred between August 9 and 13. This suggests that a common agent and a common set of circumstances acted over a short period of time.

The cross-connection between the lawn sprinkling system and the public water supply may be considered as the initiating factor of the epidemic because of these circumstances:

1. All the cases occurred in households supplied by the water main contaminated by the cross-connection on Mr. X's property.

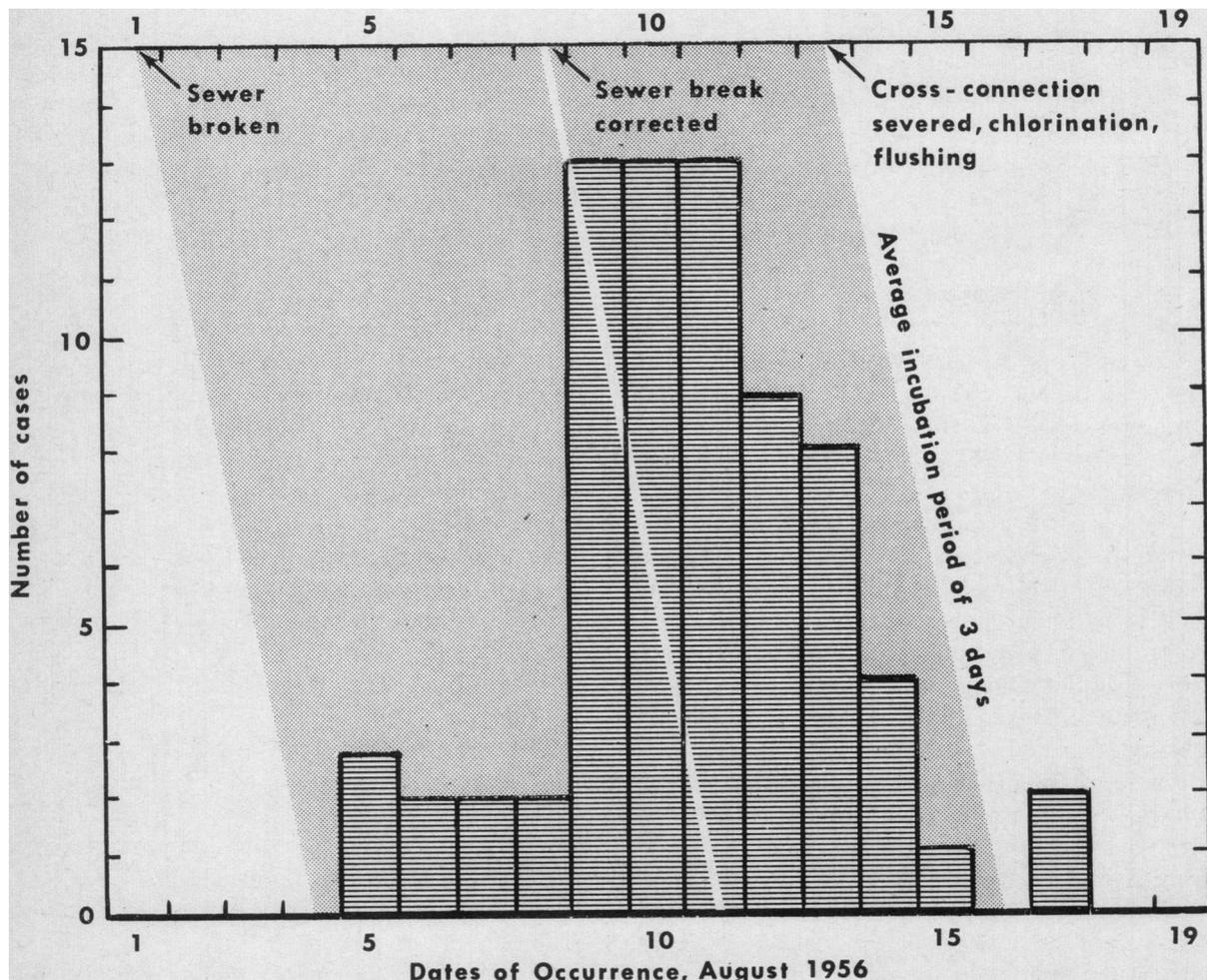
2. The bayou water was heavily contaminated because of the sewer break near Mr. X's property.

3. The dye test showed that the bayou water was reaching the city main in a relatively short interval.

4. The water pressure in the sprinkling system was greater than in the public water supply.

5. The gate valves in the sprinkler system

**Occurrence of cases of enteritis in relation to incubation period, sewer break, correction, and beginning of control measures, Shreveport, La., 1956**



line were frozen open, allowing the bayou water to flow into the public system.

6. The sewer break was corrected on August 8, and 3 days later the number of cases began to decrease.

7. The last primary case occurred 3 days after the cross-connection was severed and the water supply received increased chlorination.

In the neighborhood where the epidemic occurred, 206 water samples were taken from 69 residences. More than one sample was taken from most households; 62 of the samples were positive, 144, negative.

These results indicate that the contaminated water supply was the offending agent: among households with no cases, twice as many had all negative samples (30) as had at least one positive sample (16); twice as many of the households with cases had at least one positive sample (15) as had all negative samples (8).

All 16 samples taken on August 11 and 13 were positive for coliform bacilli. After chlorination was begun and the cross-connection was severed, 1 sample in every 4 was positive. This ratio later decreased to 1 in every 5, and after August 23 no more positive samples showed up.

Considering that the first cases occurred August 5 and the last two on August 17, the outbreak was probably caused by a stepped-up contamination of the water system beginning when the sewer line was broken (see chart). Since the buildup of contamination in the bayou water took several days, heavy contamination conceivably did not reach the property of Mr. X until August 6 or 7. With 3 days incubation for the offending agent, heavy contamination should have been reflected in a peak of cases about August 9; the actual peak was August 9-11.

The precipitous decrease in the number of cases began 6 days after the sewer break was corrected. This decrease is expected if we accept the premise of the incubation period and of dilution lessening sewage contamination in the bayou.

The epidemic apparently began to subside because the sewer line was repaired. But straggling cases may have been prevented by the later control measures, whose effect should have

been manifest by August 16. On that date, no new cases occurred (see chart).

The case distribution among families seems to indicate that none of those occurring up to August 11, the last day of the epidemic's peak, were family contacts. Of the 24 subsequent cases, 13 could have stemmed from family contacts, including the last 2, occurring on August 17 in households where other persons had enteritis about a week earlier.

No definite bacterial agent was isolated in stool examinations. The sequence of events, however, does fit the theory of an agent with a 3-day incubation period. The illnesses could also have been caused by a filtrable virus.

We must consider the possibility that the epidemic was caused by sewage intoxication. If this was true, then the epidemic should have ceased several days after the control measures were taken on August 13. For all practical purposes this actually happened (see chart). The plausibility of intoxications is partly affirmed by the fact that no definitive causative bacterial agents were isolated from stool specimens, although a viral agent remains a possibility. But if intoxication was the cause, then the presumption of contact cases is invalid.

The specific offending agent of the epidemic remains unknown. A bacterial source is possible, but a viral agent, a sewage intoxicant, or a combination of offending agents is also plausible. That the vehicle of transmission of the offending agent was the bayou water is quite clear, and that the offending agent was associated with the sewer break is circumstantially evident.

If more information on water supply hazards had been exchanged between the local public utilities department and the health department, action to control the epidemic would probably have been quicker.

### **The Official Response**

As a result of these events, the Shreveport City Council adopted an emergency ordinance requiring that all sprinkler systems be registered with the city plumbing inspector, and the plumbing board urged that the plumbing code be enforced to the letter.

## Control of Silicosis in Vermont Granite Industry

*PHS Publication No. 557. 1957. 65 pages. 40 cents.*

Results of a study of the effectiveness of methods to prevent silicosis in the Vermont granite industry are described in this progress report. It traces early studies of silicosis in the industry and developments in engineering control of granite dust, describes the current silicosis control program, and presents findings of a re-study conducted in 1955 by the Public Health Service in cooperation with the Vermont Department of Health.

The report demonstrates that great strides can be made in national control of silicosis by properly applied medical and engineering measures.

## Patients in Mental Institutions, 1955

**Part I. Public Institutions for Mental Defectives and Epileptics**

**Part II. Public Hospitals for the Mentally Ill**

**Part III. Private Hospitals for the Mentally Ill and General Hospitals With Psychiatric Facilities**

**Part IV. Private Institutions for Mental Defectives and Epileptics**

*PHS Publication No. 574. 1958. Part I, 55 pages. Part II, 72 pages. Part III, 41 pages. Part IV, 26 pages.*

Based on the 30th Annual Census of Patients in Mental Institutions, the ninth to be conducted by the National Institute of Mental Health, these publications present basic statistical data on the movement of the patient population of mental institutions in each State and in the United States.

The public institution and public hospital reports, parts I and II, con-

tain detailed tables on first admissions, resident patients, personnel employed, and expenditures for the care of patients. Parts III and IV carry data on the characteristics of first admissions to private mental hospitals and to private institutions for mental defectives. Statistics on the characteristics of discharges from general hospitals with psychiatric facilities are also included in part III.

## Public Participation in Medical Screening Programs

**A Sociopsychological Study**

*PHS Publication No. 572. 1958. By Godfrey M. Hochbaum. 23 pages; tables and charts. 15 cents.*

Results of an intensive behavioral research study on determinants of voluntary participation in free medical screening programs are reported in this monograph. Although tuberculosis case-finding programs were used as source material for the study, the methodology and findings can be applied to screening activities in other disease detection programs. The findings relate to such factors as information, fear, socioeconomic level, and social forces. The study was sponsored by the National Tuberculosis Association and the Public Health Service.

## Education, Training, and Utilization of Sanitary Engineers

*National Academy of Sciences, National Research Council Publication. 1957. 17 pages.*

Findings and recommendations of the Conference on Education, Training, and Utilization of Sanitary Engineers are summarized under three headings: career opportunities,

recruitment and recruitment incentives, and educational objectives.

The conference was held under the auspices of the Subcommittee on Personnel and Training of the Committee on Sanitary Engineering and Environment of the National Academy of Sciences, National Research Council in Washington, D. C., March 1957.

Copies of the report can be obtained from the Division of Sanitary Engineering Services, Attention: Engineering Resources Program, Public Health Service, Washington 25, D. C.

## Births and Neonatal Deaths By Birth Weight: Reporting Areas, 1952-54

*Vital Statistics—Special Reports. Selected Studies. Vol. 47, No. 1, Dec. 16, 1957. 19 pages; tables.*

This is the second in a series of reports compiling comparative statistics on neonatal mortality by birth weight for States and cities. Vital records for 1952-54 served as a basis for the data, with information on mortality by birth weight obtained from certificates for matched births and neonatal deaths.

Distributions of births by weight and weight-specific neonatal mortality rates for white and nonwhite infants, as well as summary figures for prematures, are included in the data.

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